



Executive Summary

ENERGY ENGINEERING ANALYSIS PROGRAM FORT SAM HOUSTON, TX

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Fort Worth District
FORT WORTH, TEXAS

CONTRACT NO. DACA63-79-C-0192

April 1984

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Houston, Texas

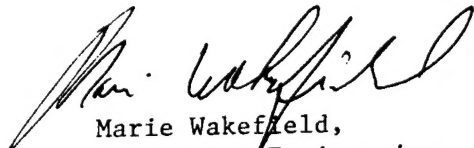


DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

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ENERGY ENGINEERING ANALYSIS PROGRAM
FORT SAM HOUSTON, TEXAS

EXECUTIVE SUMMARY

Prepared for

Department of the Army
Corps of Engineers
Fort Worth District
Fort Worth, Texas

Contract No. DACA63-79-C-0192
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Prepared by

CRS Group Inc.
Houston, Texas

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April 1984

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FORT SAM HOUSTON, TEXAS

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| VOLUME I: | Program Overview | (Final Report, October 1983) |
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| VOLUME III: | Increment B | (Final Report, October 1983) |
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| VOLUME V: | Increment C | (Final Report, April 1984) |
| VOLUME VI: | Increment F | (Final Report, April 1984) |
| APPENDICES: | Building Data Base | (Final Report, October 1983) |

Within each volume is a detailed Table of Contents for that volume.

1. INTRODUCTION

The CRS Group Inc. is pleased to submit this report on Increments C, F and G of the Energy Engineering Analysis Program (EEAP) for Fort Sam Houston, Texas. Increments A and B were completed and the final reports were submitted in October 1983. This work was accomplished under Contract No. DACA63-79-C-0192 with three modifications. The associated volumes, general contents, level of completion and contract modification numbers are listed in TABLE ESI.

TABLE ESI
REPORT SUMMARY

| <u>Volume</u> | <u>Contents</u> | <u>Level of Completion</u> | <u>Date</u> | <u>Modification</u> |
|---------------|--------------------|--------------------------------|-------------|---------------------|
| I | Program Overview | Final Report | Oct. 1983 | -- |
| II | Increment A | Final Report | Oct. 1983 | P00006 |
| III | Increment B | Final Report | Oct. 1983 | -- |
| IV | Increment G | Final Report | Apr. 1984 | P00002 |
| V | Increment C | Final Report | Apr. 1984 | P00004 |
| VI | Increment F | Final Report | Apr. 1984 | P00004 |
| Appendices | Building Data Base | Final Report | Oct. 1983 | -- |

The EEAP at Fort Sam Houston has been completed under a variety of Modifications and associated Scopes of Work and ECIP Guidances. For example, the original contract work was done under the 5 November 1979 Scope of Work and 7 November 1977 ECIP Guidance, while Modification P00006 was completed using the 22 September 1982 Scope of Work and 31 December 1982 ECIP Guidance. This has resulted in projects being analyzed using energy to cost (E/C) and benefit to cost (B/C) ratios of varying minimums as well as Savings to Investment (SIR) ratios. Applicable analysis criteria is identified in each Volume.

1.1 Report Format

The work presented in these volumes represents final results on all contracted Increments (A, B, G, C, F) and the Appendices.

As this work has been done under varying scopes of work, a copy of the applicable Detailed Scope of Work has been included in appropriate volumes (specifically in Volume I for Increments A and B; in Volume IV for Increment G, and in Volume V for Increments C and F).

1.2 ECIP Documentation

Forwarded to FWD and Fort Sam Houston were copies of the programming documents for the ECIP's (DD Forms 1391 and PDB's) completed from Increments A, B, C and G.

1.3 Overview

This report consists of six volumes and a set of appendices in which the EEAP results are presented. All calculational routines for the analyzed Energy Conserving Measures (ECM's) are either explicitly presented or the computer code employed is referenced. The purpose of the presentation is to allow others to follow the procedures in a straight-forward manner. Costs of implementing an ECM are also shown, broken out by labor and material where applicable, referenced and adjusted to the Fort Sam Houston market. Where appropriate, applicability lists have been prepared identifying where the ECM's are to be implemented. Additionally, ECIP Economic Analysis Summary Sheets, Detailed Cost Estimates and Life Cycle Cost Analysis Summary Sheets are included where appropriate. A brief overview of each volume is presented below.

1.3.1 Volume I (Final) presented general information used throughout the program. The EEAP objectives were reviewed, and the contract and modifications were identified. A data base of building information was available which was found adequate for use in calculating potential energy savings. Corrections were incorporated into the data base as found during site visits. The data base was presented as part of the Appendices volume.

1.3.1.1 A detailed Baseline Assessment of Fort Sam Houston was carried out which covered applicable previous work, local climate, energy consumption history, energy costs and end use. Factors which could impact the implementation of an ECM were investigated. Finally, the Scope of Work for this contract and modification, References, Abbreviations and Acronyms were presented. (The References and Abbreviations and Acronyms sections are included in each volume to aid the reader.)

1.3.2 Volume II (Final) contained the methodology used, analysis and summary of the ECM's investigated for Increment A: Buildings including Family Housing. (Applicable ECIP projects were updated to current ECIP criteria and economic analysis as specified in Contract Modification P00006.)

1.3.3 Volume III (Final) contained the Increment B work. Covered in this volume were the methodology, a baseline assessment and analysis of ECM's relevant to the utilities and distribution systems at Fort Sam Houston. The EMCS methodology, analysis and ECIP results were also presented, and a section on metering was included.

1.3.4 Volume IV (Final), presents the work under Increment G - a detailed analysis of those ECM's developed in Increments A and B which did not qualify under the ECIP criteria. Also included in this volume is one additional ECIP: FM Controls for Air Conditioners in AFH.

1.3.5 Volume V (Final) covers the work under Increment C: Renewable Energy including one ECIP as called for in Modification P00004.

1.3.6 Volume VI (Final) covers the work under Increment F: Facility Engineer's Conservation Measures.

1.3.7 The Appendices Volume (Final) contained the Fort Sam Houston EEAP data base consisting of:

APPENDIX A: Introduction
Weather Data

APPENDIX B: Introduction
Building Categories
Low Energy Users
Non-Buildings
Load Profiles
Building Data Sheets
Duplicate Buildings
Duplicate/Master Index

2. EXISTING ENERGY CONSUMPTION

Basewide consumption records from FY75 show that the vast majority of consumed energy at Fort Sam Houston consists of electricity and natural gas. In FY75, Fort Sam Houston used 1,236,338 source MBtu (millions of Btu's) or 106,580,862 metered kWh of electricity at a cost of over \$2.2 million. During that same period, 617,137 source MBtu of natural gas were purchased for \$0.8 million. Additionally, liquid petroleum products were used at Fort Sam Houston. The records also indicate that significant amounts of the following fuels were consumed during FY75:

- Aviation Gas: 10,665 barrels
- JP-4 (aviation turbine fuel): 12,487 barrels
- Motor gasoline: 12,836 barrels
- Diesel fuel: 2,807 barrels

2.1 Basewide Consumption FY80

In FY80, 1,421,523 source MBtu (122,545,093 metered kWh) of electricity at a cost of over \$4.2 million were used. During that same period, 562,081 source MBtu of natural gas were purchased for over \$1.6 million. The use of petroleum products at Fort Sam Houston shows a significant drop in FY80 compared to FY75 as follows (percentage decrease in parentheses):

- Aviation gas: 725 barrels (93%)
- JP-4 (aviation turbine fuel): 10,508 barrels (16%)
- Motor gasoline: 8,062 barrels (37%)
- Diesel fuel: 1,211 barrels (57%)

2.2 Basewide Consumption FY82

In a more recently completed Fiscal Year, FY82, 1,553,024 source MBtu (133,881,371 metered kWh) of electricity at a cost of \$6.2 million were used. During that same period, 536,256 source MBtu of natural gas were purchased for \$2.4 million.

3. RESULTS

The EEAP at Fort Sam Houston has investigated over 40 projects for energy conservation. Of these, eight met ECIP criteria and have been recommended for implementation. All projects are detailed in the volumes of the EEAP submittal. This EEAP was originally contracted under the 5 November 1979 General Scope of Work (GSOW) and associated ECIP Guidance dated 7 November 1977 which required ECM's to be analyzed using energy to cost (E/C) and benefit to cost (B/C) ratios. Recently, Modification P00006 was incorporated into the contract to update those ECIP's not yet forwarded for funding to the 22 September 1982 GSOW and 31 December 1982 ECIP Guidance.

3.1 Energy Conservation Measures (ECM's)

TABLE ES3 lists the FY83 projects as ranked by E/C ratios. For FY83 ECIP projects, the E/C ratio was to be equal to or greater than 18.0; the B/C ratio was to be equal to or greater than 1.0. These projects are complete and programming documents have been forwarded to the Post and FWD.

TABLE ES3
FY83 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|---|
| III/3.2.1 | Conversion to High-Pressure Sodium Street Lighting (ECIP) |
| | CWE: \$84,169 |
| | Energy Savings: 3,760 MBtu/yr (source) Electricity |
| | E/C: 45 |
| | B/C: 2.0 |

This project was limited to historic street lights.

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RESULTS
(Continued)

ENERGY ENGINEERING ANALYSIS PROGRAM
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TABLE ES3 (Continued)
FY83 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> | | | | |
|----------------------------|--|------------------------|------------------------|-------------------------|-----------------------|
| II/5.2 | Conversion of Constant Volume to Variable Air Volume | | | | |
| | <u>Eddy Current Clutch</u> | | | | |
| | <u>Number of Zones</u> | <u>Cost (FY80)</u> | <u>Cost (FY83)</u> | <u>E/C Barracks</u> | <u>E/C Office</u> |
| | 1 | \$6,925 | \$8,248 | 17.3 | 5.0 |
| | 2 | \$6,300 | \$7,503 | 19.0 | 5.5 |
| | 3 | \$6,350 | \$7,563 | 18.9 | 5.4 |
| | 4 | \$6,400 | \$7,623 | 18.7 | 5.4 |
| | <u>Single Inlet Fan</u> | | | | |
| | <u>Number of Zones</u> | <u>Cost (FY80)</u> | <u>Cost (FY83)</u> | <u>E/C Barracks</u> | <u>E/C Office</u> |
| | 1 | \$4,025 | \$4,794 | 35.7 | 10.3 |
| | 2 | \$3,400 | \$4,049 | 42.3 | 12.2 |
| | 3 | \$3,450 | \$4,109 | 41.6 | 12.0 |
| | 4 | \$3,500 | \$4,169 | 41.0 | 11.8 |
| | <u>Double Inlet Fan</u> | | | | |
| | <u>Number of Zones</u> | <u>Cost (FY80)</u> | <u>Cost (FY83)</u> | <u>E/C Barracks</u> | <u>E/C Office</u> |
| | 1 | \$7,425 | \$8,843 | 19.3 | 5.6 |
| | 2 | \$6,800 | \$8,099 | 21.1 | 6.1 |
| | 3 | \$6,850 | \$8,158 | 21.0 | 6.0 |
| | 4 | \$6,900 | \$8,218 | 20.8 | 6.0 |

Not developed as an ECIP, because the EMCS ECIP achieves similar savings plus additional control.

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(Continued)

ENERGY ENGINEERING ANALYSIS PROGRAM
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TABLE ES3 (Continued)
FY83 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|---|
| II/4.5 | Retrofit Existing 40-Watt Fluorescent Tubes with High Efficiency 35-Watt Tubes and Ballasts CWE: \$22.87/fixture Energy Savings: 0.599 MBtu/yr fixture (source) E/C: 26.2 This was determined to be a maintenance item, not an ECIP project, since changeout of tubes alone is considered by FWD to be maintenance. To qualify as an ECIP project, fixtures must be replaced. |
| II/4.2 | Solar Reflective Film (ECIP) CWE: \$283,732 Energy Savings: 11,159 MBtu/yr (source) Electricity -5,709 MBtu/yr (source) Natural Gas Total Energy Savings: 5,450 MBtu/yr (source) Energy Annual Dollar Savings: \$39,787/yr E/C: 19.2 B/C: 1.1 |
| II/8.2 | Storm Windows Cost: \$ 3.95/SF Energy Savings: 0.062075 MBtu/yr (source) Energy E/C: 15.7 |

EXECUTIVE SUMMARY
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(Continued)

ENERGY ENGINEERING ANALYSIS PROGRAM
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Volume/
Section Title/Notes

III/3.1.3 Replacement of Standard 150°C Rise Transformers with 80°C Rise,
Pad-Mounted, Dry-Type Transformers

TRANSFORMER REPLACEMENT COST AND BENEFIT

| Transformer Rating | Cost per Transformer | Number of Applications | B/C | E/C | Payback |
|------------------------|-------------------------|---------------------------|-----|-----|---------|
| 225 kVA-2400/4160v-3 | \$10,309 | 1 | 1.5 | 14 | 11.3 |
| 750 kVA-7960/13800v-3 | \$29,827 | 3 | 1.5 | 14 | 11.5 |
| 750 kVA-2400/4160v-3 | \$26,387 | 4 | 1.4 | 12 | 12.3 |
| 1000 kVA-7960/13800v-3 | \$36,780 | 2 | 1.3 | 12 | 12.9 |
| 225 kVA-7960/13800v-3 | \$13,452 | 7 | 1.3 | 12 | 13.3 |
| 150 kVA-2400/4160v-3 | Not | 3 | 1.2 | 11 | 13.8 |
| 112.5 kVA-7900/13800-3 | Available | 2 | 0.8 | 8 | 21.1 |
| 300 kVA-2400/4160v-3 | \$12,642 | 1 | 0.8 | 7 | 21.5 |
| 500 kVA-2400/4160v-3 | \$21,643 | 2 | 0.8 | 7 | 21.6 |
| 500 kVA-7960/13800v-3 | \$25,051 | 14 | 0.7 | 6 | 25.2 |
| 300 kVA-7960/13800v-3 | \$18,474 | 3 | 0.6 | 5 | 31.3 |

II/4.4 Wall Insulation

CWE: \$1.87/SF
Energy Savings: 0.012486 MBtu/yr SF
E/C: 6.7

III/3.1.1 Replace Overhead Conductors on 2400/4160 Volt and 7960/13800
Volt Primary Lines

Energy Savings: 0.154 MBtu/yr (source)

Insignificant energy savings plus expensive cost - no further
analysis.

TABLE ES3 (Continued)
FY83 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|---|
| III/3.1.2 | Install Capacitor Banks to Improve Power Factor Fort Sam Houston pays no penalty for low power factor as capacitor banks are now being used. If loads increase, capacitive correction should be implemented as needed. |
| III/3.2.2 | Replace 361 300-Watt Incandescent Street Lamp Bulbs with 143-Watt Energy-Conserving Bulbs Energy Savings = 2,879.6 MBtu/yr (source) Electricity More energy is saved by high-pressure sodium lighting. Also, luman output would be decreased from 5,700 lumens/bulb to 2,380 lumens/bulb. |
| III/3.2.3 | Replace 140 400-Watt Mercury Lamps with 360-Watt High-Pressure Sodium Lamps (No Ballast Change Required) Cost: \$ 68.00/lamp (January 1980) Energy Savings: 284.5 MBtu/yr (source) Electricity Cost for mercury lamps is \$25.00/lamp; life of the lamp is 24,000 hrs. Life of HPS lamp is only 16,000 hrs. |
| III/3.2.4 | Replace 142 175-Watt Mercury Tubes with 150-Watt High-Pressure Sodium Tubes (No Ballast Change Required) Cost: \$ 63.50/tube (January 1980) Energy Savings: 180.4 MBtu/yr (source) Electricity Cost for 175-Watt mercury tubes is only \$18.75/tube with 24,000 hr life. Life of HPS 150-Watt tube is only 12,000 hrs. |

TABLE ES3 (Continued)

FY83 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|--|
| III/3.2.5 | Replace 142 175-Watt Mercury Tubes with 100-Watt High-Pressure Sodium Tubes and Ballasts |
| | Cost: \$163.14/tube and ballast (Jan. 1980) |
| | Energy Savings: 541.1 MBtu/yr (source) Electricity |
| | Cost for 175-Watt mercury tube is only \$18.75 for the same tube life as the HPS tubes. |
| II/5.3 | Evaporative Precoolers for Air-Cooled Condensers |
| | Energy Savings: Negative at half load |

3.2 FY85 Projects

TABLE ES4 lists FY85 projects. For FY85 projects, the E/C ratio was to be equal to or greater than 13.0; the B/C ratio was to be equal to or greater than 1.0. These projects are complete and programming documents have been forwarded to the Post and FWD.

TABLE ES4

FY85 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|--|
| II/8.1 | Energy Conserving Projects for Family Housing (ECIP) |
| | CWE: \$686,010 |
| | Energy Savings: 13,938 MBtu/yr (source) Electricity |
| | 22,450 MBtu/yr (source) Natural Gas |
| | Total Energy Savings: 36,388 MBtu/yr (source) Energy |
| | Annual Dollar Savings: \$191,051/yr |
| | E/C: 53.0 |
| | B/C: 3.4 |

TABLE ES4 (Continued)

FY85 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|--|
| III/6 | Energy Monitoring and Control System (ECIP) |
| | CWE: \$989,811 |
| | Energy Savings: 45,978 MBtu/yr (source) Electricity |
| | 3,409 MBtu/yr (source) Natural Gas |
| | Total Energy Savings: 49,387 MBtu/yr (source) Energy |
| | Annual Dollar Savings: \$188,515/yr |
| | E/C: 49.9 |
| | B/C: 2.54 |
| II/4.1 | Roof Insulation (ECIP) |
| | CWE: \$553,976 |
| | Energy Savings: 15,070 MBtu/yr (source) Electricity |
| | -4,071 MBtu/yr (source) Natural Gas |
| | Total Energy Savings: 10,999 MBtu/yr (source) Energy |
| | Annual Dollar Savings: \$ 93,140/yr |
| | E/C: 20 |
| | B/C: 2.81 |
| II/7.1 | Energy Conserving Improvements to Hospital and Beach Pavilion (ECIP) |
| | CWE: \$221,999 |
| | Energy Savings: 1,295 MBtu/yr (source) Electricity |
| | 2,310 MBtu/yr (source) Natural Gas |
| | Total Energy Savings: 3,605 MBtu/yr (source) Energy |
| | Annual Dollar Savings: \$ 19,008/yr |
| | E/C: 16.2 |
| | B/C: 1.65 |
| II/6.1 | Barracks Chiller Heat Recovery |
| | CWE: \$363,061 |
| | Energy Savings: -1,186 MBtu/yr (source) Electricity |
| | 5,247 MBtu/yr (source) Natural Gas |
| | Total Energy Savings: 4,061 MBtu/yr (source) Energy |
| | Annual Dollar Savings: \$ 16,813/yr |
| | E/C: 11.2 |
| | B/C: 0.99 |

3.3 FY86 Projects

TABLE ES5 lists FY86 projects. These projects were analyzed using the 22 September 1982 GSOW and the 31 December 1982 ECIP Guidance under Modification P00006. To qualify as an ECIP under these guidelines, the SIR must be equal to or greater than 1.00. These projects are complete and programming documents have been forwarded to the Post and FWD.

TABLE ES5
FY86 PROJECTS

| <u>Volume/ Section</u> | <u>Title/Notes</u> |
|----------------------------|---|
| II/5.1 | Efficiency Improvements in Large Boilers (ECIP) Base Construction Cost: \$265,846 (June 1983) Energy Savings: 6,655 MBtu/yr (source) Fuel Oil 7,504 MBtu/yr (source) Natural Gas Total Energy Savings: 14,159 MBtu/yr (source) Energy Total Net Discounted Savings: \$1,244,469 SIR: 4.28 |
| II/6.2 | Waste Heat Recovery from Laundry Equipment (ECIP) Base Construction Cost: \$225,600 (June 1983) Total Energy Savings: 8,233 MBtu (source) Natural Gas Total Net Discounted Saving: \$759,525 SIR: 3.08 |

3.4 FY87 Projects

TABLE ES6 lists FY87 projects from Increment G and Increment C solar projects which were analyzed using the 22 September 1982 GSOW and the 31 December 1982 ECIP Guidance. These projects are complete and programming documents have been forwarded to the Post and FWD.

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ENERGY ENGINEERING ANALYSIS PROGRAM
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TABLE ES6
FY87 PROJECTS

| <u>Volume/ Section</u> | <u>Title</u> | <u>Base Construction Cost (\$)</u> | <u>Net Discounted Savings (\$)</u> | <u>Total Source Energy Saved (MBtu/yr)</u> | <u>SIR</u> |
|----------------------------|--|--|--|--|------------|
| IV/4.3 | FM Controls of Air Conditioners in AFH (ECIP) | \$173,474 | \$508,393 | 5,990 | 2.68 |
| V/8.3 | Indoor Pool (ECIP) (Bldg. 2868) Solar Pool Heating | \$144,238 | \$304,400 | 3,506 | 1.93 |
| V/8.4 | Outdoor Pool* (Bldg. 2302) Solar Pool Heating | \$250,620 | \$433,118 | 5,554 | 1.58 |
| IV/4.6 | Add Dampers to Fireplace Chimneys | \$209,550 | \$205,193 | 2,173 | 0.90 |
| V/3.1 | Salt Gradient Solar Pond (One Family House) Solar DHW & SH | \$5,642 | \$3,246 | 56.2 | 0.53 |
| V/3.4 | Solar Gel Pond (One Family House) Solar DHW & SH | \$5,699 | \$3,228 | 56.2 | 0.52 |

* If used all year. After the preliminary analysis was completed, a directive closing the pool in winter was issued negating virtually all savings.

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ENERGY ENGINEERING ANALYSIS PROGRAM
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TABLE ES6 (Continued)
FY87 PROJECTS

| <u>Volume/ Section</u> | <u>Title</u> | <u>Base Construction Cost (\$)</u> | <u>Net Discounted Savings (\$)</u> | <u>Total Source Energy Saved (MBtu/yr)</u> | <u>SIR</u> |
|----------------------------|--|--|--|--|------------|
| IV/4.2 | Insulating Suspended Floors | \$493,080 | \$165,245 | 1,750 | 0.31 |
| V/8.6 | Hospitals (Bldg. 1000) Solar DHW | \$81,297 | \$23,256 | 560 | 0.26 |
| IV/4.1 | Caulk & Weatherstrip AFH | \$1,330,906 | \$335,909 | 9,019 | 0.23 |
| V/8.5 | Troop Medical Clinic (Bldg. 1279) Solar DHW Only | \$20,290 | \$409 | 82.62 | 0.02 |
| IV/4.5 | Off-Peak Water Pumping | \$11,375 | \$191,274 | -0- | -0- |
| V/8.5 | Troop Medical Clinic (Bldg. 1279) Solar DHW & SH | \$28,373 | \$-2,723 | 80.66 | -0.09 |
| IV/4.4 | Attic Ventilation in AFH | N/A | N/A | Negative | N/A |

3.5 FY87 Non-Solar Projects

TABLE ES7 lists FY87 non-solar projects analyzed under Increment C. These projects were analyzed using the Life Cycle Cost Analysis specified in ETL 1110-3-332.

TABLE ES7
SUMMARY OF INCREMENT C NON-SOLAR PROJECTS

Wind Energy (one 25 kW machine):

| | | |
|-------------------------|---|---------------|
| Total Construction Cost | = | \$52,367 |
| Annual Energy Savings | = | 254.7 MBtu/yr |
| Annual Dollar Savings | = | \$ 1,922 |
| DeltaLCC | = | -\$39,533 |

Geothermal:

Not recommended due to piping distance from well to Fort Sam Houston.

Biomass (RDF):

| | | |
|-----------------------|---|---|
| Construction Cost | = | can be up to \$3,500,000 for payback in 25 years. |
| Annual Energy Savings | = | 58,810 MBtu/yr |
| Annual Dollar Savings | = | \$443,868 |

Nuclear:

Not recommended due to large costs and relatively small electrical demand at Fort Sam Houston.

3.6 Increment F

Increment F site surveys have shown that, in general, responsibility for O&M procedures are well defined, but there is some confusion at the Fort regarding SARPMA's role. Responsibility for energy conservation is a gray area in many buildings with some occupants actually hostile to the idea, interpreting energy conservation as the opposite of comfort. Other Increment F work focused on O&M opportunities for energy conservation measures which are under the control and within the funding authority of the Facility Engineer.

3.6.1 The following table lists the major areas studied with the best and worst SIR for an individual project in each area. This comparison is shown so that the range of SIR's within each group can be easily seen.

| <u>Volume/Section</u> | <u>Title</u> | <u>Individual Project</u> | |
|-----------------------|---|---------------------------|------------------|
| | | <u>Best SIR</u> | <u>Worst SIR</u> |
| VI/4.1 | DHW Tank Temperature Setback | 15.78 | 1.10 |
| VI/4.2 | Pipe Insulation on Hot and Cold Media Transport Pipes | 28.63 | 0.00 |
| VI/4.3 | DHW Boosters for Dishwashers | 1.83 | 0.12 |
| VI/4.4 | Separate DHW/Space Heat Boilers | 254.44 | 0.00 |
| VI/4.5 | Install Air Curtain | 6.88 | -2.36 |

3.6.2 Contained in these five analysis sections are 347 separate SIR calculations for individual projects specific to Fort Sam Houston economics. While every individual project may not have a specific application at Fort Sam Houston at this time, the results of these analyses can be used by the FE now and in the future to identify those projects for implementation when FE manpower and funds are available. Obviously, with such a wide range of economic results, each individual project should be checked in the appropriate section for economic feasibility before implementation.

4. ENERGY PLAN

The totals for the implementation of the eight recommended ECIP's are summarized in TABLE ES8.

TABLE ES8
SUMMARY OF RECOMMENDED ECIP'S

| ECIP Title | Project Year | Source Electricity Savings (MBtu/yr) | Source Natural Gas Savings (MBtu/yr) | Total Energy Savings (MBtu/yr) | CWE* Costs (\$) |
|---|--------------|--------------------------------------|--------------------------------------|--------------------------------|-----------------|
| Energy Conserving Projects for Family Housing | FY85 | 13,938 | 22,450 | 36,388 | \$686,010 |
| Energy Monitoring and Control System | FY85 | 45,978 | 3,409 | 49,387 | \$989,811 |
| Roof Insulation | FY85 | 15,070 | -4,071 | 10,999 | \$553,976 |
| Energy Conserving Improvements to Hospital and Beach Pavilion | FY85 | 1,295 | 2,310 | 3,605 | \$221,999 |
| Efficiency Improvements in Large Boilers | FY86 | -0- | 14,159** | 14,159 | \$360,544 |
| Waste Heat Recovery from Laundry Equipment | FY86 | -0- | 8,233 | 8,233 | \$305,963 |
| FM Controls of Air Conditioners in AFH | FY87 | 5,990 | -0- | 5,990 | \$242,011 |
| Indoor Pool Solar (Building 2868) | FY87 | -0- | 3,506 | 3,506 | \$201,225 |
| TOTALS | | 82,271 | 49,996** | 132,267 | \$3,561,539 |

* CWE is the current working estimate for the project year of implementation.

** Includes 6,655 MBtu/yr source fuel oil.

4.1 ECIP Savings

The savings from these eight ECIP's are shown in TABLE ES9 where a comparison to the base year (FY75) and the current year (FY82) energy use is made.

TABLE ES9
ECIP ENERGY SAVINGS AND COMPARISON TO FY75 AND FY82 USE

| <u>Energy</u> | <u>ECIP Savings in Source MBtu/yr</u> | <u>FY75 Use in Source MBtu</u> | <u>FY82 Use in Source MBtu</u> |
|-------------------------------|---|--|--|
| Electricity (% Reduction) | 82,271 | 1,236,338 (6.65%) | 1,553,024 (5.30%) |
| Gas/Fuel Oil (% Reduction) | 49,996 | 617,137 (8.10%) | 536,256 (9.32%) |
| TOTALS (% Reduction) | 132,267 | 1,853,475 (7.14%) | 2,089,280 (6.33%) |

Percent reduction for FY75, for example, is calculated as:

Electricity: $\frac{\text{ECIP Savings}}{\text{FY75 Electricity Use}}$

$$100\% \times \frac{82,271 \text{ MBtu/yr}}{1,236,338 \text{ MBtu/FY75}} = 6.65\%$$

Gas & Fuel Oil: $\frac{\text{ECIP Savings}}{\text{FY75 Gas/Fuel Oil Use}}$

$$100\% \times \frac{49,996 \text{ MBtu/yr}}{617,137 \text{ MBtu/FY75}} = 8.10\%$$

TOTAL: $\frac{\text{ECIP Savings}}{\text{FY75 Energy Use}}$

$$100\% \times \frac{132,267 \text{ MBtu/yr}}{1,853,475 \text{ MBtu/FY75}} = 7.14\%$$

5. RECOMMENDATIONS

It is recommended that all eight ECIP's from Increments A, B, C and G be funded.

5.1 ECIP Implementation

Implementation of these ECIP's will reduce by 7.14 percent (FY75 base year) energy consumption at Fort Sam Houston - an Army facility which has implemented energy conserving modifications successfully in the past (e.g., insulation of buildings and an Energy Management and Control System).